

CLAIMS

What is claimed is:

1. A spinal fixation system, comprising:
5 at least two bone anchors;
 a rod connecting the bone anchors; and
 a connecting plate extending from a proximal surface of at least one of
the bone anchors.
- 10 2. The spinal fixation system of Claim 1, wherein each of the bone anchors
includes a distal portion and a rod receiving portion, whereby the rod connects
the bone anchors.
- 15 3. The spinal fixation system of Claim 2, wherein the rod receiving portion defines
the proximal surface.
4. The spinal fixation system of Claim 3, further including a set screw that
threadably engages the rod receiving portion, whereby the set screw contacts
and fixes the rod to the bone anchor.
- 20 5. The spinal fixation system of Claim 4, further including a cap that threadably
engages the set screw, whereby the cap fixes the connecting plate to the rod-
receiving portion of the bone anchor.
- 25 6. The spinal fixation system of Claim 5, wherein the connecting plate defines an
opening at an end and a spanning portion extending from the end, and wherein
the set screw or the cap extend through the opening when the connecting plate is
fixed to the bone anchor.

7. The spinal fixation system of Claim 6, wherein the connecting plate includes a buttress at a distal side of the spanning portion.
8. The spinal fixation system of Claim 7, wherein each of two sets of bone anchors are connected by rods and wherein the two sets of bone anchors are connected to each other by connecting plates.
9. The spinal fixation system of Claim 6, wherein proximal surface of the bone anchor has a bearing surface that mates with the connecting plate and wherein the connecting plate has a distal bearing surface that is domed.
10. The spinal fixation system of Claim 9, wherein the domed bearing surface of the connecting plate is spherical or conical.
11. The spinal fixation system of Claim 10, wherein the cap has a distal bearing surface that is chamfered or domed.
12. The spinal fixation system of Claim 11, wherein the connecting plate has a proximal bearing surface that mates with the distal bearing surface of the cap.
13. The spinal fixation system of Claim 11, further including a floating washer, the floating washer including a bearing surface that mates with the distal bearing surface of the cap, and rails that slidably engage the connecting plate, whereby the connecting plate is fixed to the bone anchor by compression between the floating washer and the bone anchor.
14. The spinal fixation system of Claim 13, wherein the distal bearing surface of the cap is domed.

15. The spinal fixation system of Claim 5, wherein the cap threadably engages the set screw at a threaded bore defined by the cap.
- 5 16. The spinal fixation system of Claim 5, wherein the cap threadably engages a threaded bore defined by the set screw.
17. The spinal fixation system of claim 1, wherein the connecting plate is oriented at an angle in a range between about 20° and about 160° relative to the rod.
- 10 18. The spinal fixation system of claim 1, wherein the connecting plate is oriented at an angle in a range between about 60° and about 120° relative to the rod.
- 15 19. The spinal fixation system of claim 1, wherein the connecting plate defines an opening at an end for receiving at least one bone anchor and a spanning portion extending from the end.
- 20 20. The spinal fixation system of Claim 19, wherein the connecting plate defines an opening at each end, and wherein each end is fixed to a proximal surface of a bone anchor.
21. The spinal fixation system of Claim 19, wherein the spanning portion of the connecting plate is arcuate.
- 25 22. The spinal fixation system of Claim 21, wherein the spanning portion has a radius of curvature in a range of between about 8mm and about 12mm.
23. The spinal fixation system of Claim 21, wherein the spanning portion has a radius of curvature in a range of between about 5mm and 15mm.

24. The spinal fixation system of claim 19, wherein the spanning portion is offset from a plane defined by the end of the connecting plate.
25. The spinal fixation system of claim 24, wherein the spanning portion is offset at
5 least about 3mm from the plane defined by the end of the connecting plate.
26. The spinal fixation system of claim 24, wherein the spanning portion is offset between about 5mm to about 10mm from the plane defined by the end of the connecting plate.
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27. The spinal fixation system of Claim 21, wherein the openings defined by the connecting plate each independently have at least a portion of a shape selected from the group consisting of a circle and an ellipse.
- 15 28. The spinal fixation system of Claim 21, wherein the opening defined by the connecting plate is open-ended.
29. The spinal fixation system of Claim 1, wherein the bone anchors are each independently selected from the group consisting of a polyaxial screw, a
20 monoaxial screw and a bolt.
30. The spinal fixation system of Claim 29, wherein the bone anchors include at least one polyaxial screw.
- 25 31. The spinal fixation system of Claim 3, wherein the distal bone anchor portion is a polyaxial screw that includes a head that mates with the rod-receiving portion and a bone screw portion, whereby the bone screw portion pivots about a point at the head of the bone screw portion.

32. The spinal fixation system of Claim 31, wherein the proximal surface of the rod receiving portion is spherical and has a radius of curvature that extends from the point about which the bone screw portion pivots.
- 5 33. The spinal fixation system of Claim 32, wherein the connecting plate defines an opening at an end of the plate and wherein the opening has a bearing surface that mates with the proximal surface of the bone anchor.
- 10 34. The spinal fixation system of Claim 32, further includes a set screw that threadably engages the rod receiving portion and a cap that threadably engages the set screw, the cap including a distal bearing surface that has a radius of curvature that extends from the point about which the bone screw portion pivots.
- 15 35. The spinal fixation system of Claim 34, wherein the polyaxial screw further includes a compression member between the rod and the head of the distal bone screw portion of the polyaxial screw, the compression member including a rod seat that substantially mates with the rod.
- 20 36. A connecting plate for connection to at least one bone anchor, comprising:
an end portion defining an opening, the opening having a distal bearing surface and a proximal bearing surface, the end portion defining at least one plane; and
a spanning portion extending from the end portion, at least a portion of the spanning portion being offset from the at least one plane defined by the end portion.
- 25 37. The spinal fixation system of claim 36, wherein the spanning portion is offset at least about 3mm.

38. The spinal fixation system of claim 36, wherein the spanning portion is offset between about 5mm.
- 5 39. The connecting plate of Claim 36, wherein the plate includes two end portions that define openings, the end portions connected by the spanning portion.
40. The connecting plate of Claim 36, wherein the spanning portion includes a buttress.
- 10 41. The connecting plate of Claim 36, wherein each of the openings include a distal bearing surface and a proximal bearing surface.
42. The connecting plate of Claim 36, wherein the spanning portion is arcuate, and wherein a distal side of the spanning plate is concave.
- 15 43. The connecting plate of Claim 42, wherein the spanning portion has a radius of curvature in a range of between about 8mm and about 12mm.
44. The connecting plate of Claim 41, wherein the distal bearing surface is domed.
- 20 45. The connecting plate of Claim 44, wherein the distal bearing surface is spherical.
46. The connecting plate of Claim 45, wherein the distal bearing surface has a radius of curvature in a range of between about 5mm and about 15mm.
- 25 47. The connecting plate of Claim 41, wherein the proximal bearing surface is concave.

48. The connecting plate of Claim 41, wherein the proximal bearing surface is convex.
49. The connecting plate of Claim 48, wherein the proximal bearing surface is spherical.
50. The connecting plate of Claim 49, wherein the radius of curvature of the proximal bearing surface is in a range of between about 5mm and about 15mm.
51. A bone anchor for use with an orthopedic device comprising:
a distal portion for engaging a bone; and
a rod-receiving portion, connected to the distal portion, for engaging a rod, wherein the rod-receiving portion defines a convex proximal bearing surface.
52. The bone anchor of Claim 51 wherein the distal portion includes a bone screw portion and a head, connected to the bone screw portion, that mates with the rod receiving portion, whereby the bone screw portion pivots about a pivot point at the head of the bone screw portion.
53. The bone anchor of Claim 52, further including a compression member, that defines a rod seat, said compression member disposed within the rod-receiving portion adjacent to the head of the bone screw portion.
54. The bone anchor of Claim 52, wherein the proximal bearing surface has a center of curvature approximately coincident with the pivot point of the head of the bone screw portion.
55. The bone anchor of Claim 52, wherein the proximal bearing surface has a radius of curvature between about 5mm and about 15mm.

56. A spinal fixation system, comprising:
- a first set of at least two bone anchors;
 - a second set of at least one bone anchor;
 - 5 a fixation element connecting the bone anchors of the first set; and
 - a connecting plate connecting a bone anchor of the first set with a bone anchor of the second set.
- 10 57. The spinal fixation system of claim 56, wherein at least one anchor includes a rod-receiving portion including a proximal bearing surface; and a distal portion, including a bone screw portion and a head that mates with the rod receiving portion, whereby the bone screw portion pivots about a point at the head of the bone screw portion; and
- 15 58. The spinal fixation system of claim 57, further comprising a closure mechanism engageable with the anchor to fix a rod within the rod receiving portion of the anchor.
- 20 59. The spinal fixation system of claim 58, further comprising a cap engageable with the closure mechanism to fix the connecting plate to the bone anchor.
60. A method of fixing vertebrae relative to each other, comprising the steps of:
- implanting a first bone anchor and a second bone anchor in a first vertebra and a second vertebra, respectively;
 - 25 connecting the first and second bone anchors with a fixation element;
 - and
 - coupling one end of a connecting plate to a proximal bearing surface of at least a portion of the first bone anchor.

61. The method of Claim 60, further including the steps of:
implanting a third bone anchor in the first vertebra on a side of the spine
opposite the first bone anchor, the third bone anchor including a proximal
bearing surface, and
5 coupling the connecting plate to the proximal bearing surface of the third
bone anchor.
62. The method of Claim 61, wherein the fixation element is a rod.
- 10 63. The method of Claim 61, further including the steps of:
implanting a fourth bone anchor in the second vertebra on a side of the
spine opposite the second bone anchor, the fourth bone anchor including a
proximal bearing surface, and
coupling a connecting plate to the proximal bearing surface of the second
15 bone anchor and to the proximal bearing surface of the fourth bone anchor.
64. A method of decompression of the spinal canal, the method comprising:
dissecting a posterior element of a vertebra;
positioning the posterior element of the vertebra to expand the spinal
20 canal; and
maintaining the position of the posterior element with a connecting plate
coupled to a bone anchor fastened to the vertebra.
65. The method of claim 64, wherein the posterior element is a portion of the lamina
25 of the vertebra.
66. The method of claim 65, further comprising making a second dissection in the
posterior element, the second dissection being on the contralateral side of the
posterior element opposite the first cut.

67. The method of claim 66, further comprising supporting the posterior element with a second connecting plate coupled to a second bone anchor fastened to the vertebra.
- 5 68. The method of claim 64, wherein the posterior element is the spinous process of the vertebra.
69. The method of claim 64, further comprising fastening the bone anchor to the lateral mass of the vertebra.
- 10 70. The method of claim 64, further comprising fastening the bone anchor to the pedicle of the vertebra.
71. The method of claim 64, further comprising coupling the connecting plate to the posterior element.
- 15 72. The method of claim 64, further comprising coupling the connecting plate to the spinous process.